DUSTSTORMS OF MAY-DECEMBER 1937 IN THE UNITED STATES

By R. J. MARTIN

[Weather Bureau, Washington, D. C., January 1938]

The year 1937 was marked by subnormal precipitation in practically all of the Great Plains area and some adjoining States. Subsoil moisture was greatly deficient and dry surface soil was easily transported by even light winds. As a result a large central area, including those portions of Colorado, Kansas, Oklahoma, Texas, and eastern New Mexico, commonly referred to as the "Dust Bowl", had numerous and severe duststorms, and some States to northward had damaging storms. Most States to east of the Mississippi River were visited by dust clouds at some time during the period covered by this paper.

This paper, with the one which appeared in the April issue of the MONTHLY WEATHER REVIEW, describes the duststorms of 1937; those of the first 4 months, January to April, inclusive, are discussed in the April issue.

A large central area, including Wisconsin and Illinois to east of the Mississippi River, and Iowa, Missouri, Montana, the Dakotas, Nebraska, Kansas, Oklahoma, Texas, Colorado, Nevada, and Arizona, received subnormal precipitation for the entire year. In this area totals ranged from only 75 percent of the normal yearly fall in Nebraska to as much as 99 percent in Nevada.

Most Great Plains States, Missouri, Illinois, Wisconsin, and Iowa had considerably more rain than in 1936, the increases over the preceding year varying from 10 percent in Kansas to 48 percent in North Dakota. Texas, with only 87 percent of normal, had 13 percent less than in 1936. In Iowa, Missouri, Wisconsin, and Illinois increases over the preceding year ranged from 5 to 20 percent, while of the Western States listed Arizona, Colorado, and Nevada had 9, 10, and 11 percent, respectively, less than in 1936.

Large areas in the Great Plains had subnormal precipitation every month of the period covered by this summary; May was the relatively driest, with only 6 States receiving normal rain, or more, to west of the 80 meridian.

MAY

During May dense dust, damaging to wheat and other crops and injurious to livestock, was reported in most States from northwestern Texas and New Mexico northward. Storms were distributed throughout the month but were most frequent from the 18th to the 28th. Severe dust was reported on as many as 21 days of the month in portions of Oklahoma and on from 4 to 15 days in southwestern Kansas. During these storms, as well as in some of those in other States, visibility was materially reduced, dangerously so in many instances.

At Malta, Mont., the storm of the 28th was the "worst ever seen—for an hour and a half dust blew at a terrific rate, so thick that the greater part of the time it was impossible to see the radiator cap on a car (from the driver's seat)—dust sifted into the closed cars until it was an inch thick. When the rain came it blew into the car doors until the dirt was mud." (Havre, Mont., Journal, May 30, 1937.) The Chinook, Mont., Opinion classified this storm as "the worst ever seen here." At Helena air and highway traffic was halted, and, in the northern part of the State, cars stopped on highways, because of poor visibility from blowing dust, were struck by other vehicles and some personal injuries resulted.

At Billings, Mont., a dust "layer" which persisted from the evening of the 23d to the early morning of the 25th was found by aviators to have an upper limit of 4,430 feet; on the 28th, when visibility was reduced to one-eighth mile for half an hour, the upper limit of the cloud was 10,000 feet above the surface.

Western and northwestern Texas had several severe storms. At El Paso, on the 22d, the visibility was 700 feet or less from 6 a. m. until nearly noon; at 7 o'clock it was only 300 feet.

The following paragraph, taken from a report submitted by the official in charge, Oklahoma City, Okla., describes the severity of some of these May storms:

> At Goodwell the visibility was reduced to ½ mile on the 1st, 150 yards on the 3d, ½ mile on the 4th, ¼ mile on the 6th, practically zero at 7:45 p. m. on the 7th, ½ mile on the 10th, ¼ mile on the 11th, 100 feet at 6:30 p. m. on the 12th, 1 mile on the 14th, ¼ mile on the 15th, 100 feet at 5:45 p. m. of the 16th and at 6 p. m. on the 17th, 150 feet on the 19th at 6 p. m., ¼ mile on the 20th, zero on the 21st from 7:09 p. m. to 11:09 p. m., ¼ mile on the 23d, 100 feet at 8:45 a. m. on the 24th, ½ mile on the 25th, 1 mile on the 26th, only 10 feet for a short time at 3:45 p. m., with some rain falling while dust was heaviest, and ½ mile on the 30th.

Similar conditions probably prevailed in other portions of the Oklahoma Panhandle and in other sections of the "Dust Bowl."

Nebraska, New Mexico, Montana, and Wyoming reported crop damage from blowing soil during the month. In North Dakota the Dickinson Experiment Station reported that soil blowing about the middle and near the close of the month was the most severe ever experienced.

The unusually numerous and severe storms in northeastern Montana were the worst ever known in that region; grain seed was blown out of the soil and growing grain cut off at the surface or buried. In Teton County grain was cut off three times this spring. Losses from soil blowing were general in the north-central and eastern portion of the State; duststorms were particularly severe and extensive on the 11th, 12th, 18th, and 28th. On the 28th slightly more than the entire eastern half of the State was visited by a severe storm that reduced visibility to 50 feet in from 10 to 30 minutes. Great damage resulted to seeded and growing grain and range grass. Air and highway traffic was disrupted. At the Billings Airport Station the wind attained an extreme velocity of 76 miles per hour and at Miles City, 68 miles.

Numerous duststorms occurred in Colorado and on the 21st the visibility was reduced to from one-quarter to one-half mile in most southeastern counties and was rendered zero in extreme southeastern counties where conditions were reported as "dark as night" and "absolutely black." In some sections the storm was the worst of the year. The swirling clouds of dust halted traffic, interrupted airplane schedules and made living conditions extremely uncomfortable. On the 28th the entire region east of the 103d meridian was covered by a dust pall which reduced visibility to from 20 to 200 feet for from 4 to 7 hours.

Light dust was much more extensive and was reported throughout the Great Plains, much of the Rocky Mountain district, in most of the Lake region and middle Mississippi Valley, and locally to eastward. Some stations noted dusty conditions on practically every day of the month and as far east as Reading, Pa., an unusual amount of dust was noted in the atmosphere from the 25th to the close of the month.

JUNE

During June the Great Plains States from Nebraska southward, Iowa, Minnesota, Wisconsin, Utah, and Nevada were among the 14 States receiving subnormal rainfall. Amounts ranged from only 47 percent of normal in Nevada to as much as 95 percent in Oklahoma.

Despite this increase of precipitation over the preceding month, duststorms were again rather severe and numerous though less so than in May. Dense duststorms were reported from Texas and New Mexico northward to Montana with frequency ranging from one occurrence to as many as 12 storms during the month.

Probably the most severe and extensive duststorm ever experienced in the history of Montana occurred on June 2–3. Dense clouds of dust overspread the State from the Rocky Mountain Divide eastward to the Dakotas and from the Canadian border southward to Wyoming, but only three stations west of the Divide, Kalispell, Philipsburg, and Butte, reported dense dust during this storm. The dust apparently moved into Montana from Canada shortly before midnight of the second and was carried by strong northwest winds aloft as there were no unusually high winds along the surface while the storm crossed the State. It struck Havre at 11:40 p. m. of the 2d, Helena about 2 a. m. of the 3d, and was at Ekalaka about noon of the 3d. The storm was followed by rains in most of the State, and the cloud had disappeared generally by the night of the 3d. During the densest part of the storm all localities reported visibilities ranging generally from 1 mile to several blocks. In some portions of the State automobile lights were necessary while driving during the day.

June rainfall in the principal duststorm region of Colorado (the extreme southeastern counties) varied from a trace to nearly 4 inches during the month.

In the region (in Colorado) east of the 104th meridian and south of the Arkansas-Platte Divide, dust occurred generally on the 4th, 11th, 12th, 13th, 17th, 18th, 19th, 20th, 22d, 23d, 24th, and 25th. The storm of the 11th–12th was the worst of the month, the visibility being reduced to from zero to 1 mile. On these two dates the storm extended northward to include Kit Carson, Yuma, and northern Lincoln Counties.

Duststorms occurred over much of the western third of Kansas on from 2 to 5 days, and were most frequent in the extreme southwestern part of the State; in Morton County they were reported on the 4th, 6th, 12th, 19th, 20th, 22th, 23th, 24th, and 26th. As a rule these storms were not as widespread as in the 3 months preceding; the one of greatest extent occurred on the 17th. None was reported in the central or eastern thirds of the State.

In Oklahoma, except for one instance on the 26th, duststorms were confined to the Panhandle, where a visibility of 150 feet prevailed at Goodwell for 20 minutes on the 1st. Duststorms were reported on as many as 12 days in portions of this area. A remarkable feature of the dense duststorms of the month in portions of western Kansas is that they occurred comparatively soon after rains that, in some instances, exceeded 3 inches. At Rock Springs, Wyo., during a dust squall on the 23d, the visibility was zero for a few moments with accompanying gusts of wind up to 70 miles per hour.

Light duststorms were nearly as widespread as in May, and were reported from the Rocky Mountains eastward to the Ohio Valley and Tennessee and even as far east as Reading, Pa., where considerable dust was suspended in the air during most of the month. Frequencies ranged from as many as 17 days with light to moderate dust in portions of the northern Great Plains to isolated occurrences in some portions of Texas, the middle Mississippi Valley, and most eastern districts. South of the fortieth parallel they were most frequent during the first half of the month while farther north they were more frequent during the latter half. On the 22d–24th light duststorms were reported in Montana, Wyoming, the Dakotas, Nebraska Iowa, and Minnesota.

JULY

Utah had 211 percent of the normal precipitation during July compared with only 72 percent in June, while Nevada had 189 percent in contrast with 47 for the preceding month. Percentages were also decidedly greater in Montana, the Dakotas, Idaho, and Wyoming than in June, while Kansas noted an increase of 16 percent over the preceding month. As a consequence duststorms were considerably less severe and more restricted in extent in these States than at any time during the preceding several months.

Dense dust occurred on 10 days in portions of Oklahoma, chiefly in the Panhandle area, where occasional zero visibility prevailed temporarily (the July rainfall in Oklahoma was 68 percent of normal, while in June it was 95), and was reported on one day in southeastern New Mexico. In Montana there were brief periods of decidedly limited visibility, ranging from one-half block to less than 1 mile, on 3 or 4 days. Elsewhere duststorms were light to moderate in character and were reported only in the Great Plains from central Texas and southeastern New Mexico northward, in portions of west-central and western Minnesota where, at Moorhead, some damage to crops occurred, and in a few central and northern Rocky Mountain districts, practically all to the east of the Divide.

The frequency of days with duststorms varied from 1 in portions of Texas, New Mexico, Minnesota, and Nebraska to 2 in Wyoming, 3 in North Dakota, 7 in South Dakota, 9 in Kansas, 10 in southeastern Colorado, 15 in Montana, and 17 in Oklahoma; nearly all of those in Oklahoma occurred in the extreme western portion of the State. None was reported east of the Mississippi River.

The storms in North Dakota were rather general on the 5th and 24th; in South Dakota they were most frequent during the first half of the month. Kansas noted dust of limited extent in southwestern counties, chiefly during the first half of the month, but no general duststorms occurred even in those sections where moisture conditions have been most serious.

In contrast to months just preceding, the most severe duststorm of July in Montana, which affected a large area, taking in the southeastern portion of the State from Yellowstone County eastward to the Dakota line and from Prairie County on the north southward to the Wyoming line on the 22d, only reduced visibility to 2½ miles when the storm was at its height.

During the dense duststorm at Roswell, N. Mex., on the 20th, poor visibility began shortly after 1 a. m., and ended at 1:41 a. m. when rain began falling; the minimum visibility, at 1:12 a. m., was only 70 yards.

AUGUST

August brought decidedly subnormal precipitation to all States from the Great Plains westward, except Oklahoma, Washington, and Oregon. Percentages of normal for the month in this area ranged from 10 in California to 88 in Texas. The above-normal precipitation over the northern Great Plains and northern Rocky Mountain region and portions of the Great Basin during July aided

in reducing dust blowing and as a result dense duststorms were rare during August, though isolated occurrences were reported occasionally during the latter half of the month and thick dust somewhat more often from Wyoming eastward to eastern South Dakota and southward to Oklahoma.

Light dust was reported to eastward of the Mississippi River in only one State, Wisconsin, while to west of the Mississippi River, in the Great Plains, duststorms occurred from Oklahoma northward to the Canadian border. The frequency ranged from 5 days or less to as many as 11 in Montana and 12 in Kansas.

In Oklahoma heavy duststorms were of local character and were confined to the central and western sections of the State; Hennessey and Kingfisher, in the central part of the State, reported heavy dust on the 19th with minimum visibility at the latter station being one-fourth mile, while at Goodwell, in the western third, visibility was 50 yards for half an hour on the 4th, one-half mile on the 19th, and 1 mile on the 28th. At Goodwell dusty conditions were noted on 10 days.

Light dust clouds were reported in Baca County, Colo., on several days. During the afternoon of the 9th duststorms of short duration reduced the visibility to 50 yards at Arriba. Though dusty conditions were reported locally on numerous dates throughout the month, they were not attended by serious damage or discomfort.

In South Dakota unseasonably high winds, accompanied by high temperatures, occurred in the eastern two-thirds on the 1st, 5th–9th, 13th–15th, 22d–24th, 27th, and 28th. Local duststorms were reported during these periods where the topsoil was dry.

Duststorms occurred on 1 or 2 days in the western third of Kansas and locally in the middle third, with from 5 to 13 days when there was more or less dust in the air in southwestern counties and 2 to 6 such days in the northwestern counties. Dates given in various counties were August 2, 4, 6, 10, 11, 13–15, 17, 26, 28, and 29; the storms of the 10th and 28th were the most extensive.

SEPTEMBER

Over most of the Great Plains area September brought more rain than the previous month, though only Montana and Oklahoma had above-normal falls. In Montana the September percent of normal was 111 as compared with 49 in August; North Dakota had 96 percent in September and only 71 in August, while Colorado and Wyoming had 90 and 68 percent as compared with 72 and 50 percent during the previous month. September precipitation was also more plentiful over the Southwest, but to east of the Mississippi the month was noticeably drier than August.

Dense dust was confined to portions of the northern and southern Great Plains area. Infrequent occurrences were reported locally in Montana and western Oklahoma, mostly during the latter half of the month; elsewhere dust was only light to moderate. Dusty conditions were reported from central Texas and southern New Mexico northward to Montana, the Dakotas, and Minnesota.

In Montana light dust was reported on 11 days, the 2d, 3d, 4th, 8th, 10th, 13th, 14th, 17th, 18th, 19th, and 21st, while further east and south practically all the duststorms occurred later in the month. In Minnesota they were noted on the 14th, 20th, 21st, and 23d, while in Kansas dusty conditions were noted on the 21st, 23d, 24th, and 27th–30th. Dusty conditions were reported in Oklahoma on 7 days during the month.

Moderate duststorms were reported on 2 days at a considerable number of stations in Nebraska; on the 21st light to moderate dust was reported in south-central counties northward to Valley and Nance Counties. On the 23d dust was again reported in this same area and northward into the northeastern counties and westward into some northwestern areas. On the 23d the dust was dense enough to obscure the sun and cause the day to be reported as cloudy.

On the 14th and 21st light dust was reported at scattered places in western and central North Dakota and on the 23d in south-central sections.

At Kenton and Goodwell, Okla., heavy dust reduced visibility considerably on the 13th and 24th–25th but no damage was reported, while at Helena, Mont., on the 17th, there were limited periods of visibility of less than one half city block.

OCTOBER

During October practically all of the Great Plains, with the exception of Texas, received subnormal precipitation; percentages ranged from 36 in South Dakota to 97 in Nebraska. Utah and Oregon were above-normal for the month, as were Texas, Arkansas, Louisiana, and all States to the east of the Mississippi River, except Michigan.

No dense duststorms were reported, although there were several occurrences of heavy dust in portions of Texas, Oklahoma, and North Dakota. Light dust was reported in Montana, Minnesota, the Dakotas, eastern Colorado, Kansas, Oklahoma, and Texas.

At Amarillo, Tex., a visibility of one-half mile prevailed for 2 hours on the 18th; the highest wind velocity during the storm was 54 miles per hour. Heavy dust in Oklahoma was confined to portions of the Panhandle, mostly on the 1st, 4th, 12th, and 18th. At Goodwell the visibility was less than one-half mile from about 11 a. m. to 4 p. m. on the 18th; the minimum visibility was 100 yards at 11:30 a. m. A few local duststorms were reported in some southwestern counties of Kansas on the 1st, 12th, and 18th; dusty conditions, not sufficiently severe to be classed as duststorms, were noted in many southwestern counties of the State on the 3d, 4th, 6th, 12th, and 18th.

In Colorado light dust and hazy conditions were reported from Julesburg and Cheyenne Wells on the 3d and 4th, from extreme eastern Baca County on the 2d, 4th, 8th, 15th, and 18th, and from extreme eastern Prowers and extreme southern Lincoln Counties on the 18th, on which date the visibility was reduced to 1 mile. The dust on the 8th in the vicinity of Two Buttes, Colo., was somewhat damaging to fields. Light duststorms were general over North Dakota on the 18th and 31st, and an automobile collision occurred during a rather severe local duststorm in Ramsey County on the 27th.

Over southern portions of the Great Plains area the duststorms occurred chiefly during the first half or immediately after the middle of the month, while farther north they were most frequent after the 17th.

NOVEMBER

Precipitation was again subnormal over a large northern and central area; percentages in portions of the Great Plains ranged from only 27 in Nebraska to 85 in Texas. Kansas received only 51 percent of the normal November fall. A letter from the official in charge at Dodge City, Kans., dated November 30th states:

> Up to the present time, the fall months of the year 1937 have been much drier than any of a like period since the beginning of the present dry cycle. Consequently the soil in this vicinity is much drier both at surface and subsoil. Conditions for blowing soil and dust are perhaps greater, at least in this immediate locality, than in any of the last several years.

Despite the general deficiency in precipitation only a few duststorms, mostly local in character, should be classified as dense, although there were occasional reports of zero visibility during the first half of the month from scattered stations in Wyoming, Nebraska, Kansas, and Oklahoma, and of 200 yards at Holly, Colo., on the late afternoon and early evening of the 27th.

Light dust was again reported from Texas northward to the Canadian border, but the number of days with dusty conditions, ranging from 1 to as many as 5 in drier portions of the area, was much less than in months just preceding.

The only heavy duststorm in Oklahoma occurred at Goodwell, Texas County, on the 26th–27th. Days with light to moderate dust were the 5th, 7th, 13th, 15th, 17th, 26th, and 27th; nearly all the dust was confined to the Panhandle. In Kansas duststorms of moderate intensity occurred in a few western counties on the 7th and in many parts of the western third of the State on the 12th; at Dodge City the duststorm on November 12 was sufficiently heavy to stop the automatic sunshine recorder.

On the 12th visibility in Colorado was reduced to one-fourth mile at times over the greater portion of the South Platte Valley and the Arkansas-Platte Divide, and to 1 mile in the Arkansas Valley east of the 104th meridian. Baca County had numerous days with light dust but no serious damage or discomfort resulted; the only dense duststorm in Colorado was the one at Holly mentioned above.

Western Nebraska reported locally dense dust on the 12th and 27th; local dust blowing occurred at scattered places in the eastern two-thirds of South Dakota on the 1st, 4th, 11th–15th, and duststorms were general throughout south-central North Dakota on the first day of the month.

At Rock Springs, Wyo., dusty conditions prevailed on the 11th with visibility reduced to zero occasionally between 7:30 and 8 p. m.

DECEMBER

Only 8 States west of the 90th meridian received subnormal precipitation during the last month of the year. These were Minnesota, Wisconsin, Louisiana, New Mexico, and the Plains States from South Dakota southward to and including Oklahoma. Percentages of normal in these States varied from only 42 in Nebraska to 98 in South Dakota. All States, except Ohio, to the east of the Mississippi River had subnormal falls.

No dense dust was reported during December and light dust was noted only in Montana, Wyoming, South Dakota, Nebraska, Kansas, and Oklahoma. Montana had light dust on 3 days, the 16th, 18th, and 30th, and all these storms were local in character. Dusty conditions were noted in Wyoming on the 5th and 6th, in South Dakota on the 7th and 31st, and considerable dust was reported in western Kansas on the 2d, with light, local storms on the 21st, 23d, 27th, and 31st. At Dodge City, Kans., the wind movement for December was the lowest for many years, which probably explains why dust occurred on so few dates. Goodwell, Okla., had light dust on the 2d and 30th, but no heavy dust was noted at that, or any other Oklahoma station, during the month.

The year closed with precipitation much below normal over a large central and northern area and duststorms, occasionally severe and resulting in considerable damage to winter grains, were reported in early January.

This paper has been compiled from the numerous reports collected and sent in by the various officials in charge and section directors of the States referred to from time to time. The reports from S. D. Flora, Topeka, Kans.; A. E. Osborn, Dodge City, Kans.; W. H. Wahlgren, Oklahoma City, Okla.; W. E. Maughan, Helena, Mont.; O. R. Roberts, Bismarck, N. Dak.; Thomas A. Blair, Lincoln, Nebr.; and H. F. Choun, Denver, Colo., have been extremely helpful and in some cases have been quoted verbatim.

WEATHER OF 1937 IN THE UNITED STATES

By J. P. KOHLER

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The outstanding event associated with the weather of the year was the great flood in the lower Ohio and Mississippi Valleys brought about by excessive rains in January over the drainage areas of the Ohio River and its tributaries, including the Wabash, the Cumberland, and the Tennessee. The monthly rainfall over the middle and southern portions of Ohio ranged consistently from above 9 inches to more than 14 inches. Over southern Indiana rainfall averaged 16.22 inches (12.20 inches above the average), in southern Illinois 11.74 inches or more than 8 inches in excess of normal. Over central Tennessee monthly falls averaged more than 16 inches and in the western division about 18.50 inches. McKenzie, Tenn., reported 23.90 inches for the month, Earlington, Ky., 22.97, Hickory, Miss., 21.48, and Evans Landing, Ind., 21.39 inches; also monthly totals for Jeffersonville, Ind., and Leavenworth, Ind., were in excess 20 inches. Many stations in southeastern Missouri and eastern Arkansas reported monthly totals in the neighborhood of 20 inches. Statistics covering the area of overflow and the damage of all kinds are not yet available, but probably will surpass all other previous great floods in the United States. A detailed discussion of rainfall over the various watersheds, river stages, and meteorological phenomena responsible for the heavy rains in the Ohio Valley during January appears in Supplement No. 37 of the MONTHLY WEATHER REVIEW.

Among other notable features of the year's weather were: The severe cold of January throughout the Rocky Mountains, north-central Great Plains and upper Mississippi Valley when mean State temperatures were the lowest of record in Washington, Oregon, California, Idaho, Nevada, Utah, Arizona, Montana, Wyoming, Colorado, and New Mexico, and the lowest of January record in the Dakotas and Nebraska, and the exceptionally warm January weather in the southeastern States, particularly in Alabama, which advanced vegetation, especially fruit, to premature stages only to be severely damaged by cold weather during March. Other features were low January temperatures in California which resulted in two destructive freezes, the backward spring weather in the northern Rockies and northern Plains States, the unusually dry spring in Montana and in the north and central Plains which was followed by the most devastating drought ever known in the extreme northeastern counties of Montana.

Drought conditions that were record breaking prevailed over Kansas almost throughout 1937; the year's moisture was deficient in every county, except those in the southeastern quarter. Near the close of the year the lack of normal rainfall in late summer and early fall months